

CLAIMS

- 1 1. A composite material comprising:
2 a first component which is a metal phosphate; and
3 a second component which is selected from the group consisting of:
4 metal nitrides, metal oxynitrides, and combinations thereof.

- 1 2. The material of claim 1, wherein said metal phosphate is a
2 lithiated metal phosphate.

- 1 3. The composite material of claim 1, wherein said first component
2 comprises a core and said second component is present on at least a portion of
3 the surface of said core.

- 1 4. The composite material of claim 1, wherein said second
2 component is disposed in at least a portion of the bulk of said first component.

- 1 5. The composite material of claim 1, wherein said metal
2 phosphate is a transition metal phosphate.

- 1 6. The composite material of claim 5, wherein said transition metal
2 is selected from the group consisting of Fe, V, Mn, and combinations thereof.

1 7. The composite material of claim 1, wherein said first component
2 has an olivine or nasicon structure.

1 8. The composite material of claim 1, wherein said second
2 component is selected from the group consisting of transition metal nitrides,
3 transition metal oxynitrides, and combinations thereof.

1 9. The composite material of claim 1, further including a dopant.

1 10. The composite material of claim 9, wherein said dopant is
2 selected from the group consisting of: carbon, a metal ion having a +2 valence,
3 a metal ion having a +3 valence, Nb^{+5} , Zr^{+4} , Ti^{+4} , W^{+6} , and combinations
4 thereof.

1 11. The composite material of claim 1, wherein said first component
2 is substitutionally doped at the phosphate site by a member selected from the
3 group consisting of: halogens, $(\text{SO}_4)^{-2}$, $(\text{SiO}_4)^{-4}$, $(\text{TiO}_4)^{-4}$, $(\text{AlO}_3)^{-3}$, and
4 combinations thereof.

1 12. An electrode comprising a composite material, said composite
2 material comprising: a first component which is a metal phosphate, and a
3 second component which is selected from the group consisting of: metal
4 nitrides, metal oxynitrides, and combinations thereof.

1 13. The electrode of claim 12, wherein said metal phosphate is a
2 lithiated metal phosphate.

1 14. The electrode of claim 12, wherein said first component
2 comprises a core and said second component is present on at least a portion of
3 the surface of said core.

1 15. The electrode of claim 12, wherein said second component is
2 dispersed in at least a portion of the bulk of said first component.

1 16. The electrode of claim 12, wherein said first component is a
2 transition metal phosphate.

1 17. The electrode of claim 16, wherein said second component is
2 selected from the group consisting of transition metal nitrides, transition metal
3 oxynitrides, and combinations thereof.

1 18. The electrode of claim 12, where said metal phosphate has an
2 olivine or a nasicon structure.

1 19. The electrode of claim 12, wherein said composite material
2 includes a dopant.

1 20. A method of making a composite material, said method
2 comprising the steps of:

3 providing a plurality of precursor compounds, said precursor
4 compounds including: a metal containing compound, a lithium containing
5 compound, and a phosphorous containing compound;

6 mixing said plurality of precursor compounds so as to form a mixture
7 thereof;

8 calcining said mixture so as to produce a lithiated phosphate of said
9 metal; and

10 subjecting said lithiated phosphate of said metal to a nitriding process
11 wherein a portion of said lithiated phosphate of said metal is converted to a
12 nitride or an oxynitride of said metal.

1 21. The method of claim 20, wherein the step of mixing comprises
2 milling.

1 22. The method of claim 21, wherein said step of milling comprises
2 ball milling.

1 23. The method of claim 20, wherein said compound of a metal
2 comprises a compound of at least one transition metal.

1 24. The method of claim 23, wherein said transition metal is
2 selected from the group consisting of: Fe, V, Mn, and combinations thereof.

1 25. The method of claim 20, wherein the step of providing a
2 plurality of precursor compounds further comprises providing a dopant
3 precursor compound.

1 26. The method of claim 25, wherein said dopant precursor
2 compound includes a member selected from the group consisting of: Nb, Mg,
3 Zr, Ti, Al, and combinations thereof.

1 27. The method of claim 20, wherein the step of subjecting said
2 lithiated phosphate of said metal to a nitriding process comprises heating said
3 lithiated phosphate of said metal to an elevated temperature in the presence of a
4 nitriding atmosphere.

1 28. The method of claim 27, wherein said nitriding atmosphere
2 includes ammonia.

1 29. A lithium battery having a cathode comprised of a composite
2 material said composite material comprising a first component which is a
3 lithiated transition metal phosphate having an olivine or nasicon structure, and

4 a second component which is selected from the group consisting of transition
5 metal nitrides, transition metal oxynitrides, and combinations thereof.

1 30. The battery of claim 29, wherein said composite material further
2 includes a dopant.

1 31 The battery of claim 29, wherein said first component of said
2 composite material comprises a core and said second component is present on
3 at least a portion of the surface of said core.

1 32. The battery of claim 29, wherein said second component of said
2 composite material is disposed in at least a portion of the bulk of said first
3 component of said composite material.